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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

00480022.3

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LA HAYE, LE

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Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

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Application no.: 00480022.3
Demande n°:

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Anmelder:
Applicant(s):
Demandeur(s):
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Bezeichnung der Erfindung:
Title of the invention:
Titre de l'invention:
Method of transmitting loopback cells through a swithching node of an asynchronous transfer mode (ATM) network

In Anspruch genommene Priorität(en) / Priority(ies) claimed / Priorité(s) revendiquée(s)

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METHOD OF TRANSMITTING LOOPBACK CELLS THROUGH A SWITCHING NODE OF AN ASYNCHRONOUS TRANSFER MODE (ATM) NETWORK

Technical field

The invention relates generally to the Asynchronous Transfer Mode (ATM) network wherein a connection is established between a source ATM device and a destination ATM device by the intermediary of a plurality of network switching nodes, and relates in particular to a method of loopbacking loopback cells from the switch engine of one of the switching nodes located on the route used by this connection.

Background

The use of ATM switching nodes in an IP network has become the most attractive solution since ATM hardware switches have been extensively studied and are widely available in many different architectures.

When a connection is established in the ATM network from a source ATM device to a destination ATM device by the

intermediary of a plurality of switching nodes, the incoming cells to a switching node are automatically routed to the next switching node of the connection. For this, each cell is composed of an ATM header and of a payload. The ATM protocol engine of the switching node identifies the incoming ATM cell using a lookup table. In the case of a valid cell (valid means belonging to an existing connection), the protocol engine performs traffic management function (traffic policing, congestion management, priority management) and queues the cell in an appropriate queue. A scheduler using priority based scheduling procedures selects queues from which cells are to be transmitted. Those cells are dequeued from their queue. Prior transmission, the protocol engine adds routing labels to the cell : the switch routing label (SRL) and the protocol engine correlator (PEC). The resulting internal cell format used within the switching node will be denominated hereafter labeled cell. The SRL contains either explicitly the destination blade or a pointer to a translation table located in the switching device and containing the explicit destination blade. The PEC is a pointer used by the protocol engine of the output adapter to identify the connection. The protocol engine in the output destination adapter receives the cell from the switching device. Similarly to the input protocol engine, it identifies the incoming cell by performing a lookup function on the appended protocol engine correlator, runs traffic management functions, queues the cell in the appropriate queues, dequeues the cell under control of a scheduler, removes the appended labels, swaps the ATM label and transmits the cell on the connection destination ATM port(s).

The ATM standards have defined Operation And Maintenance (OAM) procedures. They are based on particular cells identified as OAM cells by means of particular values of the payload type indicator (PTI) field of the ATM cell header. Some ones of the OAM cells are called loopback cells. They can be either segment or end to end loopback cells and may contain optionally in

their payload a source and a destination address indication. The ITU-T I610 specifications define the procedures to be performed by a network equipment when receiving OAM loopback cells. In particular they define two loopback locations for a switching node, the input adapter and the output adapter, and the loopback condition algorithm using the cells parameters (source address, destination address, segment or end to end). These procedures, by allowing to loopback cells on a connection path, at various locations (input or output adapter of the various switching nodes on the connection path) are used either to monitor the connection or for problem determination and failure isolation in the case of a failing connection.

When OAM cells such as loopback cells are received in a switching node of a connection, a classical way to process would be to transmit said cells to a dedicated resource such as a local processor that would perform the OAM procedures. But, such a solution is not appropriate and is expensive inasmuch as it requires to incorporate microprocessors on the adapter card of the switching node whereas the normal connection cells use ASIC modules which are data processing units specifically designed for the routing of the ATM cells.

Summary of the invention

Accordingly, the object of the invention is to achieve a method using principally the normal resources of a switching node in the transmission of the ATM cells, for switching loopback cells from a port of an adapter in the switching node as input port directly to the same port of the same adapter used as output port for the loopback cells.

The invention relates therefore to a method of transmitting a loopback cell of a connection established between a source ATM device and a destination ATM device of an ATM network, said loopback cell being loopbacked in one of the switching

nodes (16) located on the connection route, said loopback cell ingressing the switching node by a port P1 of adapter B1 and being switched to the output adapter B2 as normal cells of the connection, and being then switched backward to adapter B1, and said loopback cell egressing the switching node by the same port P1 of the same adapter B1 instead of port P2 of adapter B2 used by normal cells of the connection. The method comprises the steps of detecting in the adapter B1 whether the incoming cell includes a loopback condition, and if so, appending to the incoming cell specific routing labels indicating that the incoming cell is a loopback cell to be loopbacked on the connection by the switch engine of the switching node, this one transferring the loopback cell directly to the port P1 of the adapter B1 by using the specific routing labels.

Brief description of the drawings

The above and other objects, features and advantages of the invention will be better understood by reading the following more particular description of the invention in conjunction with the accompanying drawings wherein :

- Fig. 1 represents a block diagram of an ATM network including several switching nodes through which a connection is established and in which the routing of a loopback cell according to the method of the invention is schematically represented.
- Fig. 2 and 3 are block diagrams representing the two half duplex flows of an ATM connection cell between port P1 and port P2 of a switching node through which an ATM connection is established.
- Fig. 4 is a block diagram representing the flow of a loopback cell from port P1 of an adapter B1 to the same port P1 of the same adapter of the switching node through which

the ATM connection is established according to the principles of the invention.

- Fig. 5 is a flow chart representing the steps of the method according to the invention.

Detailed description of the invention

Fig. 1 shows an example of an ATM network 10 implementing the system according to the invention, and comprising four switching nodes 12, 14, 16 and 18 being respectively connected to local consoles 20, 22, 24 and 26. Each switching node is composed of a Control Point (CP) blade and a plurality of adapter blades, which provide the physical attachments to network devices such as the other switching nodes or the user workstations and a switch engine (X) providing cell switching between its ports on which are attached the adapter blades. The local console attached to the CP blade in each node is used for the network and control management. Note that each blade includes an input and an output adapters.

It is assumed that a connection in dotted lines in Fig. 1 is established between the source switching node 12 and the destination switching node 18 through the intermediary switching nodes 14 and 16. For this connection, a cell inputs each switching node by an input adapter and outputs the switching node by an output adapter after being switched by the switch engine of the node. According to the principles of the invention, a loopback cell is received by an input adapter of the switching node 16 and is switched by the switch engine of node the switching in order to be transmitted back over the connection by the same adapter.

As illustrated in Fig. 2, the transfer of normal ATM cells through a switching node is as follows. The ATM cells of a given connection are received by a port P1 of the input adapter B1. They are composed of a ATM label VP1-VC1 (virtual

path-virtual circuit) and a payload. First, the protocol engine of adapter B1 identifies the incoming cell using the ATM label lookup 40. The lookup function is in fact an address resolution performed on the source port P1 and the ATM label VP1-VC1. The lookup result is a pointer to the connection control block LCBA1 (leaf control block address). The connection control block contains the information necessary to process the incoming cell, that is information used to run the traffic management function and information used to forward the cell: a switch routing label (SRL) indicating the destination blade B2 and a protocol engine PEC correlator (PEC) which is the pointer in the output adapter used to perform the label swap (LCBA2). Then, the protocol engine enqueues the cell in an appropriate queue 42. A scheduler using priority based scheduling procedures selects the queue from which the cells are to be transmitted and dequeues those cells from the selected queue. Then, the append routing header function 44 appends the routing label B2 and the protocol engine correlator LCBA2 to the cell which is transmitted to switch engine 46.

Using the appended SRL B2, switch engine 46 transmits the cell to the output adapter B2. Similarly to the protocol engine of the input adapter, the protocol engine of the output adapter identifies the cell in the routing label lookup function 48, runs traffic management functions, queues the cell in the appropriate queue 50 and dequeues the cell under the control of a scheduler. Then, the routing labels B2 and LCBA2 are removed by remove label function 52, and the ATM label is swapped to the new label pointed by LCBA2 in the connection control block, that is VP2-VC2. At last, the protocol engine transmits the cell on destination port P2 also pointed by LCBA2 in the connection control block.

Reciprocally, when a cell is received by port P2 of input adapter B2, its ATM header is VP2-VC2 as illustrated in FIg. 3. The routing pointer resulting from the label lookup is the

pointer LCBA2 pointing to the target adapter identification P1 and the pointer to the connection control block LCBA1 in adapter B1. These two labels are appended to the cell before transmitting it to switch engine 46. Then, in output adapter B1, the routing labels are removed and the ATM header is swapped to VP1-VC1 given by pointer LCBA2 in the connection control block of adapter B1.

It is clear from the above description that the connection control block pointers LCBA1-LCBA2 for the P1 to P2 half-duplex connection, are the same as connection control block pointers for the P2 to P1 half-duplex connection. Thus, the connection being full duplex, symmetrical operations are performed on the cell flow received by port P2 of adapter B2 and the cell flow received by port P1 of adapter B1. Such symmetrical operations are being used to achieve the invention as explained hereafter.

It is assumed now that the incoming cell is a OAM loopback cell received in input adapter B1 from port P1. The cell content is analysed with the defined OAM procedures. It is assumed hereafter that conditions are met to loopback the cell in the input adapter B1. Such a condition being detected as soon as the cell is received, a loop condition bit is set in a specific register or in the cell buffer control block. At this stage it is useful to indicate that a loopback may not be allowed in the switching node being considered. It is why a loop control bit has to be set by the control point of the switching node in the connection control block for the loopback to be allowed. If the loop control bit is set, a loopback flag is added to the cell after that the label lookup 40 is performed.

When the cell includes a loopback flag meaning that both loop condition bit and loop control bit are set to 1, the switch routing label and the protocol engine correlator pointed by LCBA1 resulting from the lookup function and appended to the cell by the append routing header function 44 are B1 and LCBA1

rather than B2 and LCBA2. Such a substitution can be easily performed by the regular resources processing the ATM traffic.

Then, using the appended SRL B1, switch engine 46 transmits the cell to the adapter B1 used as output adapter. At this stage, the cell is equivalent to a cell that would have been received by the switching node on the connection reverse path : figure 3 and 4 show that the cell is received by output adapter B1 with the same connection identifier which is the appended PEC LCBA1. The protocol engine in output adapter B1 runs its regular process. It identifies the cell using LCBA1, runs traffic management functions, queues the cell in the appropriate queue, dequeues the cell under the control of a scheduler, removes from the cell the routing labels (SRL and PEC) and performs the ATM label swap. It is noted here that the label swap for a regular ATM cell flowing on the connection reverse path swaps VP2-VC2 into VP1-VC1 while for a loopbacked cell, it swaps VP1-VC1 into VP1-VC1. Although this has no effect on the label value, the function is still performed thus allowing the output adapter to perform strictly its regular process and to minimize the loopback overhaed processing in the protocol engine. Then, the loopback cell is transmitted over the network by port P1 of adapter B1.

The method according to the invention is represented by the flow chart illustrated in Fig. 5. After an incoming cell is received on port P1 of adapter B1 (step 60), a check is performed (step 62) to determine whether loopback conditions are met. If so, a loop condition bit is set in a register or in the cell buffer control block (step 64). Then, the label lookup function is performed whose result is the pointer LCBA1 to the connection control block containing the routing labes (SRL B2 and PEC LCBA2) and the loop control bit. This function enables to determine whether the loop control bit is set (step 68). If so, the appended switch routing label is B1 and the appended protocol engine correlator is LCBA1 (step 70). The cell is then

switched by the switch engine to the output adapter B1 in order to be transmitted on the same port P1 from which it had been received (step 72).

When the incoming cell is not determined as being a loopback cell or when the loop control bit is not set, the regular routing labels, SRL B2 and PEC LCBA2, are appended to the cell (step 74) before this one is switched by the switch engine to output adapter B2 and then transmitted over the network on port P2 of adapter B2 (step 76).

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CLAIMS

1. Method of transmitting a loopback cell of a connection established between a source ATM device (12) and a destination ATM device (18) of an ATM network, said loopback cell being loopbacked in one of the switching nodes (16) located on the connection route, said loopback cell ingressing said switching node by a port P1 of adapter B1 and being switched to an adapter B2 as normal cells of the connection, and being then switched backward to adapter B1, and said loopback cell egressing the switching node by the same port P1 of the same adapter B1 instead of port P2 of adapter B2 used by normal cells of the connection,

said method being characterized by the following steps :

- detecting in said adapter B1 whether the incoming cell includes a loopback condition, and if so
- appending to said incoming cell routing labels indicating that said incoming cell is a loopback cell to be loopbacked on said connection by the switch engine (46) of said switching node, said switch engine transferring said loopback cell to said port P1 of said adapter B1 by using said routing labels.

2. Method according to claim 1, wherein said routing labels are appended to said loopback cell only if a loop control bit is set by the control point of said switching node in said adapter B1.

3. Method according to claim 2, wherein said routing labels includes a switch routing label indicating adapter B1 instead of adapter B2 as output adapter and a protocol engine correlator set to a pointer LCBA1 to the connection control block in adapter B1 instead of pointer LCBA2 to the connection control block in adapter B2

4. Method according to claim 3, wherein a loopback flag is added to said loopback cell if said loop control bit is set in order to indicate to the protocol engine of said adapter B1 that routing labels B1 and LCBA1 have to be appended to said loopback cell instead of B2 and LCBA2.

5. Method according to any one of claims 1 to 4, wherein the ATM header VP1-VC1 (virtual path-virtual circuit) of said loopback cell is not swapped by the protocol engine of said adapter B1 before said loopback cell is transmitted over said ATM network by port B1 of said adapter B1.

6. System in a switching node (16) for transmitting a loopback cell comprising means adapted for carrying out the method according to any one of claims 1 to 5.

METHOD OF TRANSMITTING LOOPBACK CELLS THROUGH A SWITCHING NODE OF AN ASYNCHRONOUS TRANSFER MODE (ATM) NETWORK

Abstract

Method of transmitting a loopback cell of a connection established between a source ATM device (12) and a destination ATM device (18) of an ATM network, the loopback cell being loopbacked in one of the switching nodes (16) located on the route used by the connection, and incoming into the switching node by a port P1 of adapter B1 and going out of the switching node by the same port P1 of the same adapter B1 instead of port P2 in adapter B2 used by the normal cells of the connection. The method comprises the steps of detecting in adapter B1 whether the incoming cell includes a loopback condition, and if so, appending to the incoming cell specific routing labels indicating that the incoming cell is a loopback cell to be loopbacked on the connection so that the switch engine of the switching node transfers the loopback cell to port P1 of adapter B1 by using the routing labels.

FIG. 1

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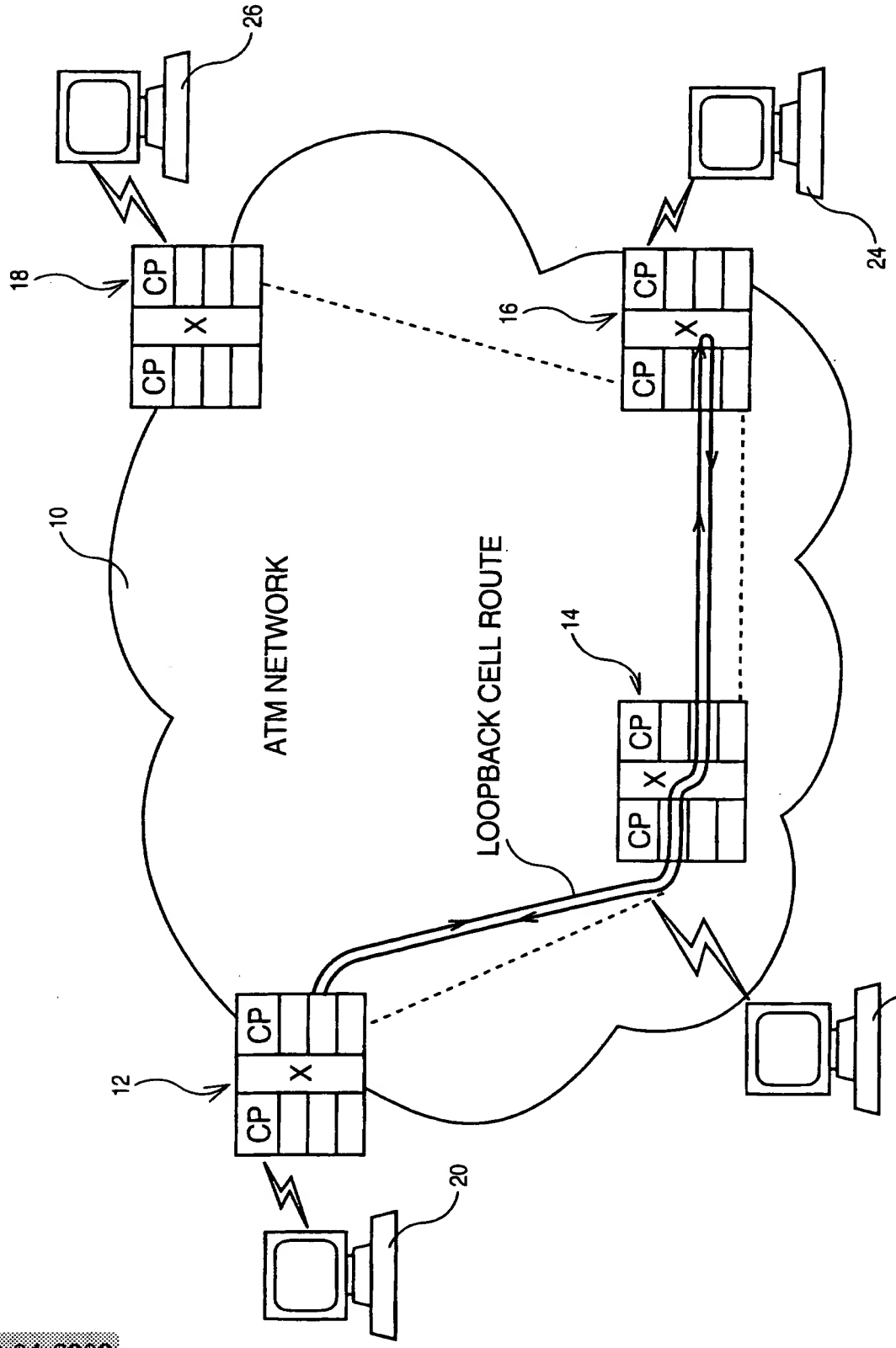
26
18
CP
X
CP
16
CP
X
CP
24
10
ATM NETWORK
LOOPBACK CELL ROUTE
14
CP
X
CP
12
CP
X
CP
20
22

FIG. 1

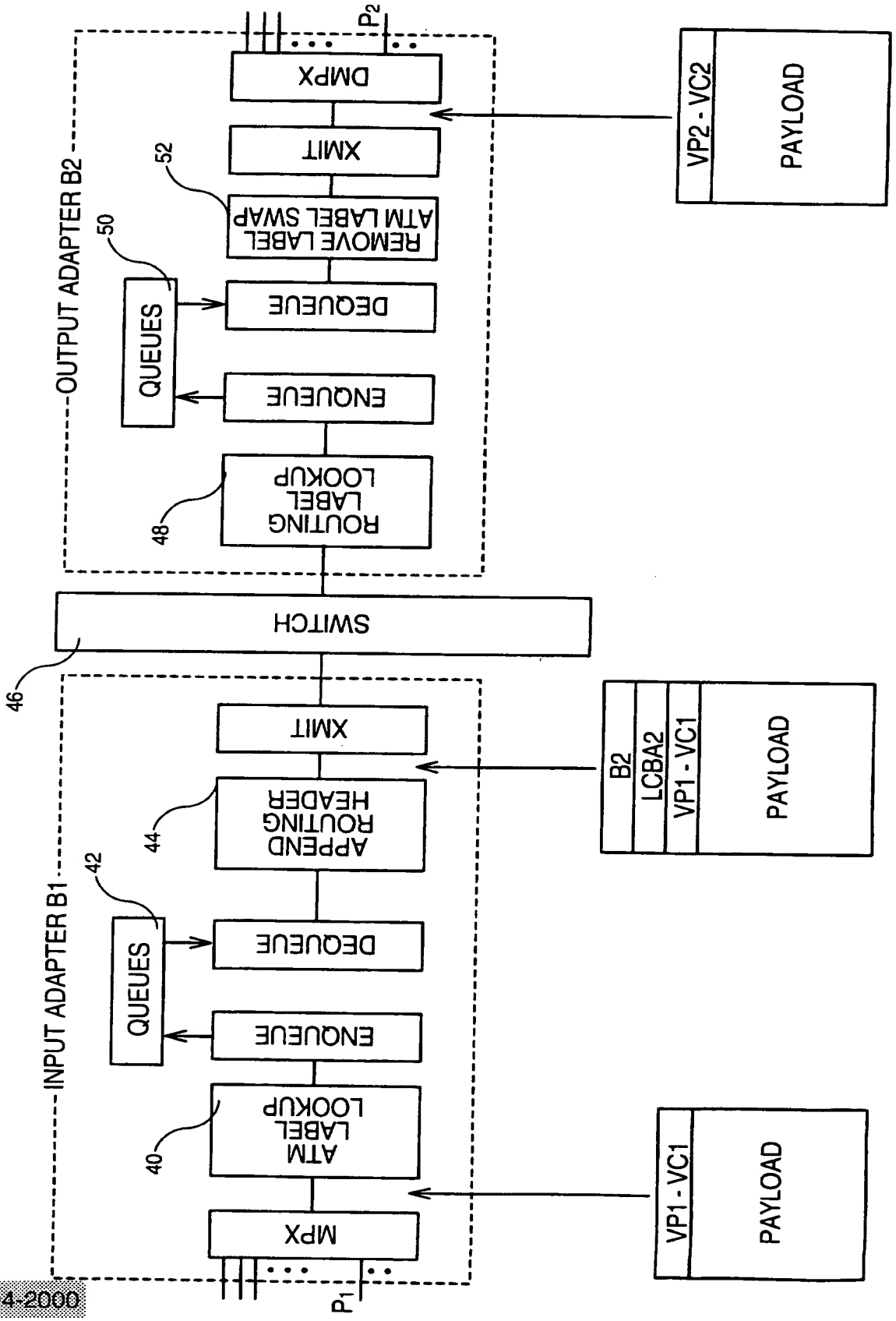
P2
DMPX
XMIT
52
REMOVE LABEL
ATM LABEL SWAP
50
QUEUES
DEQUEUE
ENQUEUE
ROUTING
LABEL
LOOKUP
48
OUTPUT ADAPTER B2
VP2 - VC2
PAYLOAD
SWITCH
46
XMIT
APPEND
ROUTING
HEADER
44
42
QUEUES
DEQUEUE
ENQUEUE
ATM
LABEL
LOOKUP
40
MPX
INPUT ADAPTER B1
B2
LCBA2
VP1 - VC1
PAYLOAD
VP1 - VC1
PAYLOAD
P1

FIG. 2

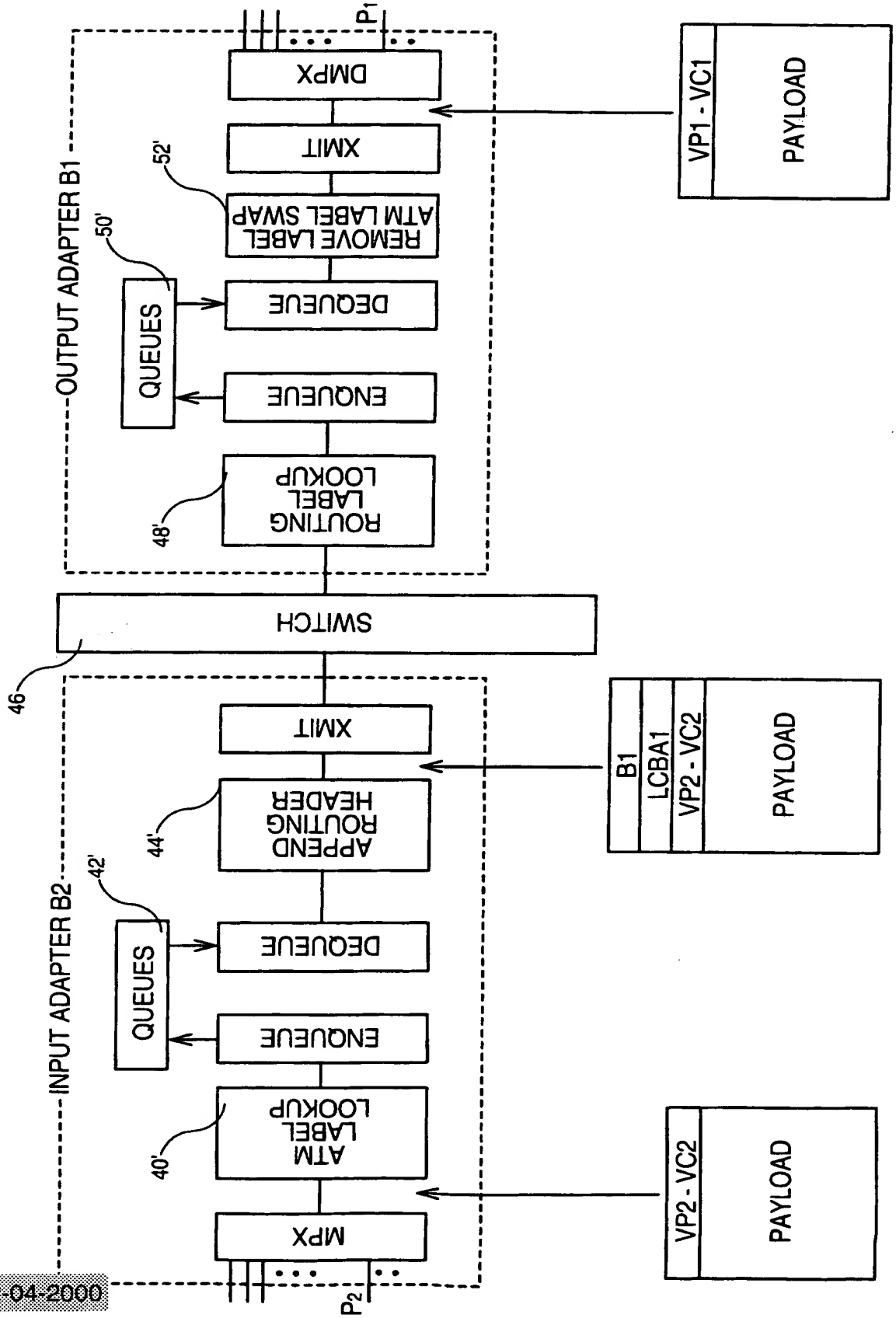
P1
DMPX
XMIT
52'
REMOVE LABEL ATM LABEL SWAP
50'
QUEUES
DEQUEUE
ENQUEUE
ROUTING LABEL LOOKUP
48'
OUTPUT ADAPTER B1
VP1 - VC1
PAYLOAD
SWITCH
46
XMIT
APPEND ROUTING HEADER
44'
42'
QUEUES
DEQUEUE
ENQUEUE
ATM LABEL LOOKUP
40'
MPX
INPUT ADAPTER B2
B1
LCBA1
VP2 - VC2
PAYLOAD
VP2 - VC2
PAYLOAD
P2

FIG. 3

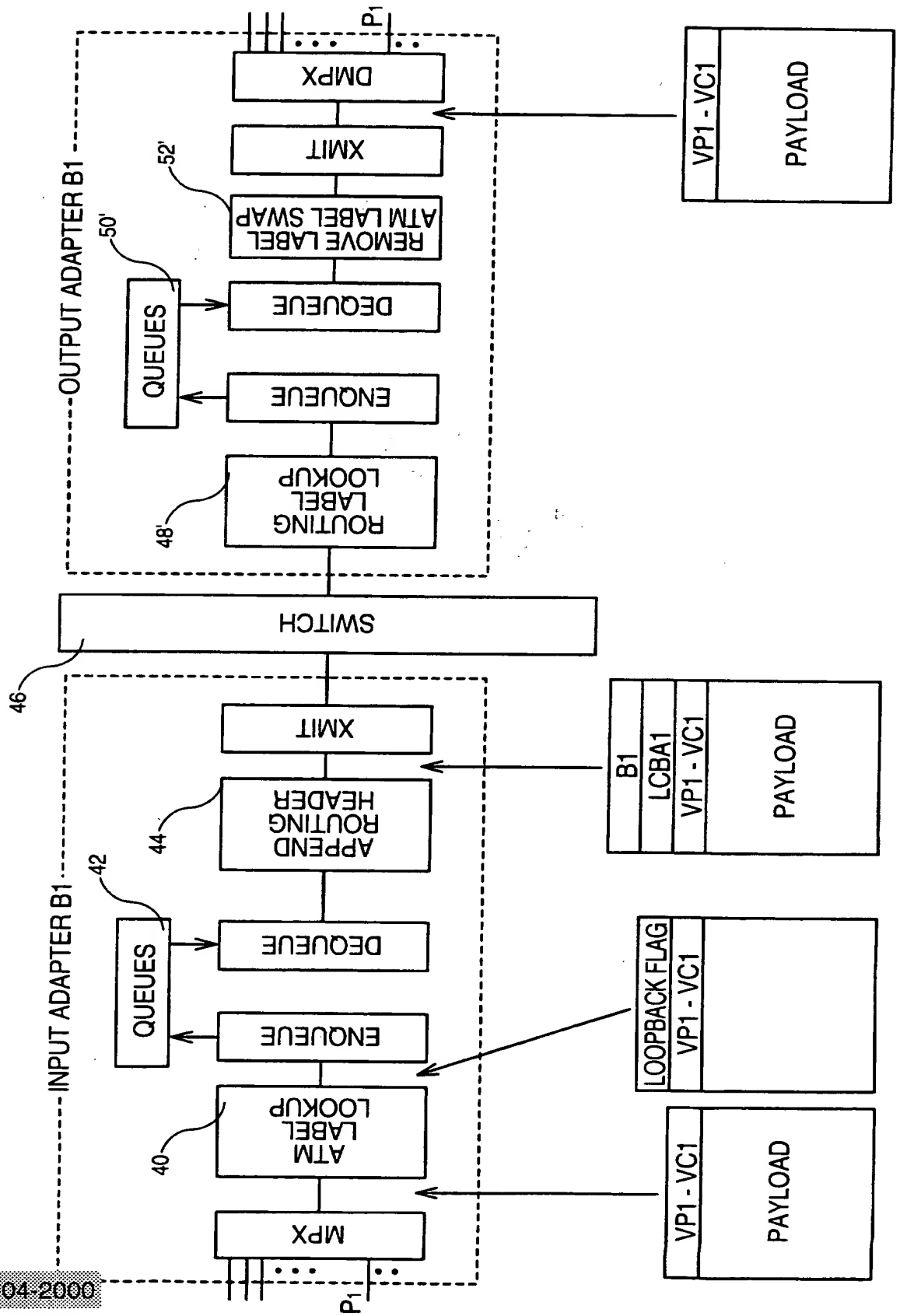
P1
DMPX
XMIT
52'
REMOVE LABEL
ATM LABEL SWAP
50'
QUEUES
DEQUEUE
ENQUEUE
ROUTING
LABEL
LOOKUP
48'
OUTPUT ADAPTER B1
VP1 - VC1
PAYLOAD
SWITCH
46
XMIT
APPEND
ROUTING
HEADER
44
B1
LCBA1
VP1 - VC1
PAYLOAD
42
QUEUES
DEQUEUE
ENQUEUE
LOOPBACK FLAG
VP1 - VC1
ATM
LABEL
LOOKUP
40
MPX
VP1 - VC1
PAYLOAD
INPUT ADAPTER B1
P1

FIG. 4

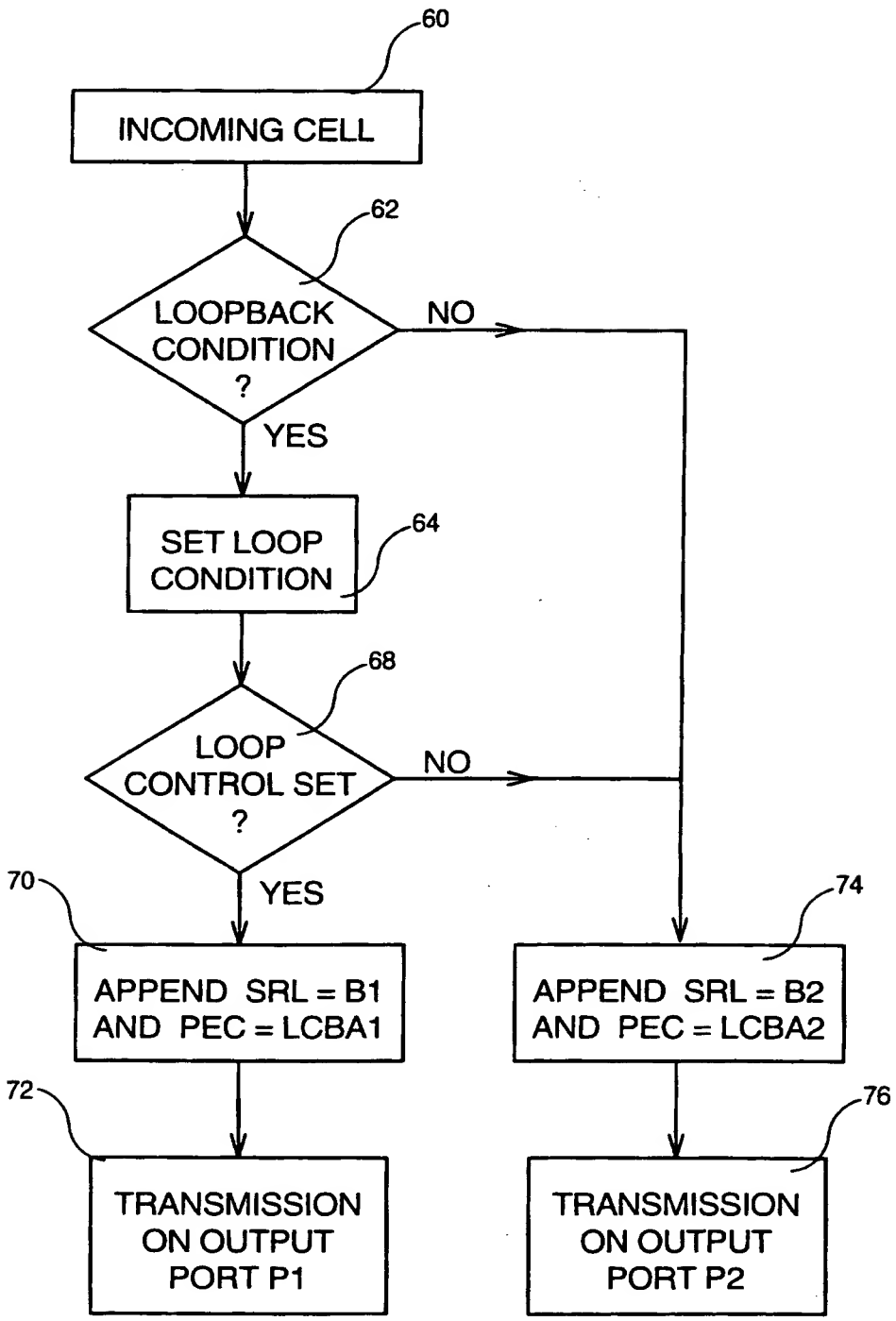
60
INCOMING CELL
62
LOOPBACK CONDITION ?
NO
YES
SET LOOP CONDITION
64
68
LOOP CONTROL SET ?
NO
YES
70
APPEND SRL = B1 AND PEC = LCBA1
74
APPEND SRL = B2 AND PEC = LCBA2
72
TRANSMISSION ON OUTPUT PORT P1
76
TRANSMISSION ON OUTPUT PORT P2

FIG. 5

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